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A Study Of Internet Protocol Digital Microwave Radio (IP DMR) Propagation Delay Affected Downtime In Oil And Gas Company

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ABSTRACT

Internet Protocol Digital Microwave Radio (IP DMR) is a significant impact on the trunk mobile communication between platform. Thus, the goal of downtime is a crucial problem especially in oil and gas company. Based on the examines from the previous issues such as relative costing based on previous hardware requirements and possible implementation, and upgrade that contribute to the long term communication flexibly on all radio in the platform system. This paper will examine the downtime that affect the network by calculate the propagation delay using SLA given and compare the SLA for Digital Microwave Radio (DMR) and Internet Protocol Digital Microwave Radio (IP DMR) that contribute to the process

1. Introduction

Digital microwave radio (DMR) communication plays a vital role in the development of high quality and high speed telecommunication system to achieve high signaling rates. In 1990s most of the oil and gas company operate in Malaysia using Digital Microwave Radio (DMR) system as telecommunication backbone to link with offshore platform, FPSO, FSO and Terminal operation. With the evolution and innovation of DMR technology, telecommunication company creates IP DMR to minimize the downtime issues and reliable equipment.

IP DMR providing transmission from the access layer to the backbone layer. It also supports Carrier Class Ethernet features for supporting the mobile backhaul evolution from GSM, UMTS to LTE. Over the past decade, microwave radios have transitioned from Time Division Multiplexing only to Time Division Multiplexing and IP/Ethernet hybrid and finally to full IP/Ethernet [1]. Packet based IP/Ethernet transport has many advantages over traditional Time Division Multiplexing in unified platform to consolidate disparate transport networks for different traffic types, lower cost to deploy and maintain, more efficient bandwidth use and easily scalable to accommodate growing capacity demands. MPLS bring the best TDM networks to packet

IP/Ethernet networks. It ensures connection between two endpoints, and QoS is guaranteed by a service-level agreement[1].

DMR have been proven as an efficient telecommunication technology as we can see it have been deployed around the world. Mobile Carriers use microwave for base-station backhaul of voice traffic for route to local PSTN [2]. Telco companies use microwave for redundant backup on critical paths, accessing remote areas to supply voice and data services, provide dedicated access to corporate users with high traffic volume, or for creating and completing VPNs for corporate users. ISPs are using microwave to create their own networks to reduce their dependence on telco to gain access to their customers and use microwave to bypass the local telco to eliminate access charges[2].

The availability of IP DMR have been prove that it can give the minimum downtime. Long-haul radio routes can be designed for 99.98 % availability over 6500 km, which translates into less than two hours of downtime per year using a single route [3]. A study was carried out comparing a single radio route versus a dual fiber route, which delivers the same network availability; radio would be cost advantageous in even more capacity/terrain states [4].

IRR DMRCN project is one of successful project in DMR which it provide a high-availability backhaul digital data network that support the safety and performance requirements. Computer Based Train Control system project in Iraq capable to monitor and managing over 20 system components (such as low fuel, tower navigation light failure, HVAC failure and instrusion entry) and 1,200 miles and interconnects the 33 major sites and stations across Iraq's railroad system [4].

2. Methodology

Deploying of IP DMR is suitable for the organization that has many branches and connection between different places. In oil and gas industry, connection between offshore and onshore consist of wireless network infrastructure such as internet connection and server farm in each oil platform is very suitable to implement. There is restraint that needs to consider such as the frequency overlapping, channel distribution, location of the tower bank on each stations and traffic situation. Field survey, frequency planning, installation and commissioning services should be consider in deploy this technology. The availability to this deployment is need to measure by collecting the propagation of the frequency planning.

Line of Sight (LOS)

The type of transmission line selected depends on the topography, the amount of information to carry, and the cost. Even though fiber optic cable carries more information with higher reliability than does any other transmission medium, for a long distance over remote or rugged terrain, a microwave relay system is sometimes the better economic alternative [5].

There is a Line of Sight *(LOS)* between onshore and offshore based on existing infrastructure and used back the current route. Telecommunication links between offshore platform and a shore facility are crucial and essential for platform operations and must be designed and selected

carefully. Typically most off shore platforms are in a relatively fixed location for long periods, and telecommunication links may be planned and implemented in a conventional manner[6].

Tower Configuration (Antenna)

Some of the platforms were already networked, but the system was very expensive, and the links were both unreliable and too slow to support the required applications. Antennas shape the RF coverage of an access point, essentially focusing the available energy into a narrow beam that has high power, or spreading it over a wider area with lower power [7].

Indoor deployments commonly use Omni-directional antennas, spreading the RF (Radio Frequency) energy uniformly in the horizontal plane, outdoor applications often require a more carefully-considered antenna choice: *distances are longer, the number of access points and availability of mounting sites are limited, stationary and moving obstructions are common and the vertical dimension is often more important.*

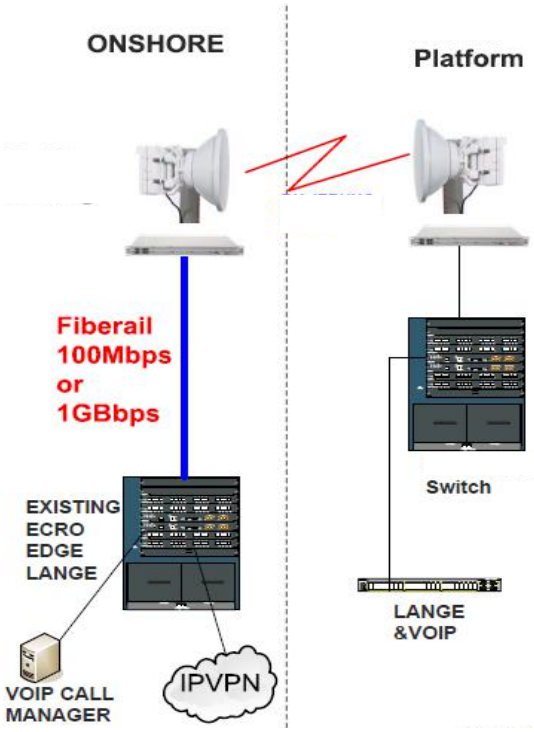

Figure 1 Conceptual Diagram of Tower Configuration

Channel Frequency

Currently it divided into four channel frequencies for onshore and offshore**.** Channel 1, 2, 3 and 4 are being licenses. Radio wave frequency includes the path loss increase as the distance increase from the base station and will result the Receive Signal Level (RSL) will decrease as distance increase.

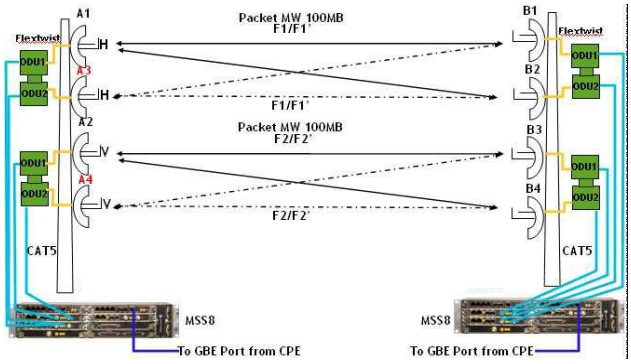

Figure 2 Frequency Planning between offshore and onshore

Traffic Interruptions

Picking the right channel is the most effective method of ensuring a wireless network's best performance especially in oil and gas platform. One of the best things is to ensure the network is performing optimally is to choose the channel with the fewest competing networks and devices.

3. Results and Discussion

Availability is an important metric used to assess the performance of repairable systems, accounting for both the reliability and maintainability properties of a component or system. Downtime is used to refer to periods when a system is unavailable. In this study, downtime refers to a period of time that a system fails to provide or perform its primary function. The availability objectives for high performance links in access networks are in the range of 99.99% to 99.999% of the time [8].

Propagation is system interruptions due to deep multipath fading often recover within 10 s, however, they sometimes occur for more than 10 s causing unavailability. Polarization is a property of waves that can oscillate with more than one orientation. In antenna there are two types of polarization which are horizontal polarization and vertical polarization.

Excessive precipitation attenuation due to heavy rainfall or snow fall lasts for a fairly long time and causes unavailability in systems operating in the frequency bands above 10 GHz [10]. Fading due to layering of the atmosphere is the dominating factor of degradation of radio-relays in the frequency bands below 8 GHz [9]. Since there is generally a low probability of heavy precipitation occurring, the unavailability time causes may differ from year to year.

To analyze the availability of IP DMR, by using proprietary software MIEA electrostatisca, the availability of antenna propagation is recorded. The result consists for both polarizations, vertical and horizontal. For IP DMR the seven nines is set to the availability compare to DMR technology the availability objective is only five nines. This propagation data will be calculated using for both availability objective.

The result will be covered to determine downtime for IP DMR and DMR. From the result the comparison of the downtime between IP DMR and DMR will be presented.

IP DMR Availability

IP DMR availability objective using seven nines as per shown in Table 1 below.

Table 1 IP DMR availability Objective

Polarization	Avalability	Downtime
Horizontal	99.99646	0.00554
Vertical	99.99724	0.00276

From the result above, an analysis have been conducted for both polarization to calculate the downtime and availability using service level agreement (SLA). This analysis can give a result of the network performance for daily, weekly, monthly and yearly as Table 2 below.

Table 2 Result Of The Network Performance For Daily, Weekly, Monthly And Yearly

Polarization	Horizontal	Vertical
Availability	99.99646	99.99724
Downtime	0.00554	0.00276
Daily	3.1 s	2.4 s
Weekly	21.4 s	16.7 s
Monthly	1 minute 33.1 s	1 minute 12.6 s
Yearly	18 minute 37.1 s	14 minute 31.0 s

Basically, the best performance of availability can get when five nines service level agreement (SLA) is implemented. Table 3 below shows the comparison when seven nines SLA is use for both polarization.

Table 3 Comparison When Seven Nines SLA Is Use For Both Polarization

Availability	99.99646	99.99724	99.99999
Downtime	0.00554	0.00276	0.00001
Daily	3.1 s	2.4 s	0 s

Weekly	21.4 s	16.7 s	0.1 s
Monthly	1 minute 33.1 s	1 minute 12.6 s	0.3 s
Yearly	18 minute 37.1 s	14 minute 31.0 s	3.2 s

To get the best availability 99.99999% is the desire of all but for IP DMR deployment with the infrastructure setup the best availability is 99.99646 for horizontal polarization and 99.99724 for vertical polarization.

DMR Availability

DMR availability objective using five nines as per shown in Table 4 below.

Table 4 DMR availability Objective

Polarization	Avalability	Downtime
Horizontal	99.996	0.004
Vertical	99.997	0.003

From the result above, an analysis have been conducted for both polarization to calculate the downtime and availability using service level agreement (SLA). This analysis can give a result of the network performance for daily, weekly, monthly and yearly as Table 5 below.

Table 5 ***Result Of The Network Performance For Daily, Weekly, Monthly And Yearly***

Polarization	Horizontal	Vertical
Availability	99.996	99.997
Downtime	0.004	0.003
Daily	3.5 s	2.6 s
Weekly	24.2 s	18.1 s
Monthly	1 minute 45.2 s	1 minute 18.9 s
Yearly	21 minute 2.3 s	15 minute 46.7 s

Basically, the best performance of availability can get when five nines service level agreement (SLA) is implemented. Table 6 below shows the comparison when seven nines SLA is use for both polarization.

Table 6 Comparison When Seven Nines SLA Is Use For Both Polarization

Availability	99.996	99.997	99.999
Downtime	0.004	0.003	0.001
Daily	3.5 s	2.6 s	0.9 s
Weekly	24.2 s	18.1 s	6.0 s
Monthly	1 minute 45.2 s	1 minute 18.9 s	26.3 s
Yearly	21 minute 2.3 s	15 minute 46.7 s	5 minute 15.6 s

Comparison Between IP DMR and DMR Downtime

Table 7 and Table 8 show the comparison of IP DMR and DMR technology downtime for daily, weekly, monthly and yearly dividing between horizontal and vertical polarization.

Table 7 Horizontal Polarization

Technology	Daily	Weekly	Monthly	Yearly
IP DMR	3.1 s	21.4 s	1 minute 33.1 s	18 minute 37.1 s
DMR	3.5 s	24.1 s	1 minute 45.2 s	21 minute 2.3 s

Table 8 Vertical Polarization

Technology	Daily	Weekly	Monthly	Yearly
IP DMR	2.4 s	16.7 s	1 minute 12.6 s	14 minute 31.0 s
DMR	2.6 s	18.1 s	1 minute 18.9 s	15 minute 46.7 s

The downtime strictly affects the network performance and availability. Thus, many organizations will well plan to ensure that they can minimize the downtime and increase the profit. Availability objective for digital microwave radio is being improved compared to microwave network. Microwave networks are dimensioned for 99.95% availability or better, which corresponds to four hours or less of downtime per year [10]. For SLA 99.95% the result as Table 9 below:

Table 9 Microwave Network Availibility

Daily	25.9 s
Weekly	3 minute 1.4 s
Monthly	13 minute 8.9 s
Yearly	2 hour 37 minute 47.1 s

Microwave network with 99.95% will cause more than 2 hours downtime which it can affect the operation cost of the company. By upgrade the microwave network to digital can be improved to the availability and reduce the downtime of the network. There are many large and established suffered from long time of downtime. An average of 501 hours of network downtime every year, and as a result are losing millions of dollars in annual productivity and revenue losses [11].

Network failure have a third rank as a top cause of downtime with represent as 19 percent. For DMR network with four nines, the cost of downtime can reach to $928, 998 while for IP DMR network can reach less than that [13]. The downtime will impact the business thru these four aspects; sales, productivity, data and satisfaction [14].

4. Conclusion

Even with advanced infrastructures and state of the art technology, businesses still face downtime and data loss. Ranging from minutes to days, downtime should be expected and every business should have a downtime recovery plan in place. It is estimated that configuration errors and other unexpected issues cost some companies' up to nearly million dollar in lost revenues according to independent research [12].

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